1983091
DELCO-2000 PHOTOVOLTAIC AND 1150
MAINTENANCE FREE BATTERY SPECIFICATION

SECTION I -- PERFORMANCE AND DURABILITY

1. GENERAL

This specification defines battery conditioning procedures for calibrated tests, as well as, the major performance and durability capabilities of batteries.

It also describes the test procedures and conditions that should be used to verify the capabilities. All ambient temperatures are to be +/- 0.6 Deg.C unless otherwise noted. This specification applies only to new, fully charged batteries unless otherwise indicated.

When tested in accordance with accepted statistical sampling procedures, 90% of the batteries should meet the and 27 Deg.C capacity ratings shown on the outline drawing, and other test values herein identified.

2. CONDITIONING PROCEDURES

The following procedures are recommended for battery laboratory sample preparation to guarantee accurate results with repeatability and comparability from one test to another. These procedures are for sample calibration and testing at various states of charge.

NOTE: These procedures are not suited for assembly plant battery charging rooms, field warranty, and diagnostic work, etc.

2.1 Suggested equipment for:

2.1.1 Discharge Constant Current
(a) Low Current Density (1-25 amps)

2.1.2 Charging Constant Voltage
(a) Current capability approx. 25 amps
(b) 14-16.5 volts controllable to +/- .05 volts

2.1.3 Stabilizing battery temperature at 0 Deg.C

2.1.4 Optional equipment to maintain ambient temperatures of 21 Deg.C to 50 Deg.C in some environments.

2.1.5 Measuring battery electrolyte temperature. Access to battery electrolyte may be gained by removing the eye.

2.1.6 Measuring discharge time in seconds, minutes, and hour.

2.1.7 Measuring terminal voltage to +/- .01 volt

2.2 Batteries to be tested at 100 percent state of charge should be

prepared as follows:

2.2.1 Battery electrolyte temperature should be 15 Deg. to 32 Deg.C at the beginning of charge. Maximum temperatures should be maintained below 43 Deg.C when using constant current charging (ref. 2.2.3). (Access to the electrolyte may be obtained as described in 2.1.5.)

NOTE: Batteries should not be placed in service after gaining access to electrolyte due to a disruption of the seal and possible bypass of the flame arrestor vent design.

2.2.2 Constant Voltage Charging (to minimize battery degradation during charge, constant voltage is preferred)

Charge the batteries at 16.0 +0.0/-0.2 volts for 24 hrs.

NOTE: Batteries rated at 160 min. reserve capacity or greater (100 AH or greater) may require longer recharge periods (40-48 hrs.) following complete discharges.

2.2.3 Constant Current Charging (optional)

Charge the battery at a current rate equal to 5% of the ampere-hour rating for 150% of the ampere-hours removed on the preceding capacity test (ref. 3.2). On new batteries, charge prior to para. 3.1 sequence at the rate above until the temp.-corrected charge voltage (27 Deg.C) changes less than .05 volts per hour (three readings taken at one hour intervals). Charge voltage decreases with increasing battery temperature by .039 volts/Deg.C.

NOTE: Constant current charging should not be used for repetitive (approx. 6-7) recharges due to the excessive voltages required and possible damage to the battery.

2.3 Batteries to be tested at other states of charge should be prepared as follows:

2.3.1 Charge the battery as described in 2.2.

2.3.2 Calculate battery capacity to be removed.

EXAMPLE:

Rated Battery Capacity = 100 ampere hours
Desired State of Charge = 80%

OR

(100%-80%) x 100 ampere-hours = 20 ampere-hours to be removed

Ampere-hour capacity may be estimated by multiplying reserve capacity by .6; i.e., 100 minutes reserve capacity times .6 equals 60 ampere-hours.

2.3.3 All ampere-hours to be removed will be done using a discharge current equal to .05 times the ampere-hour rating of the battery.

2.3.4 To calculate discharge time, divide ampere hours to be removed by the discharge current.

3. PERFORMANCE-ELECTRICAL

All batteries tested on capacity tests should be conditioned to 100% state of charge as outlined in Section 2.2 of this specification prior to the sequence below:

3.1 Sequence of Test

3.1.1 Capacity Test (ref. para. 3.2.1)

3.1.2 Reserve Capacity Test (ref. para. 3.2.2)

3.1.3 Repeat 3.1.1

3.1.4. Repeat 3.1.2

3.1.5 Repeat 3.1.1 and 3.1.2 if necessary to meet published ratings.

3.1.6 Perform life tests as applicable.

3.2 Capacity Test

3.2.1 Ampere-hour capacity

The fully charged battery at a temperature of 27 Deg.C is discharged to a voltage of 1.75 volts/cell at a rate equal to 5 percent of the rated ampere-hour capacity of the battery.

Measured capacity is the product of discharge rate times hours to 1.75 volts/cell.

Results should be corrected for temperature at the end of discharge by the formula:

$$A.H.c = A.H.r \quad 1-.01\ (Tf-27\ Deg.C)$$

Where: A.H.c = Ampere-hours corrected
A.H.r = Ampere-hours recorded
Tf = Electrolyte temperature at end of test in Deg.C

Test is valid if Tf is 21 Deg.C to 32 Deg.C

3.2.2 Reserve Capacity

The fully charged battery at a temperature of 27 Deg.C is discharged 25 +/- 0.25 amperes to a terminal voltage of 1.75 volts/cell. Reserve capacity is defined as the time

of discharge in minutes, All results shall be corrected to 27 Deg.C standard. This shall be accomplished by maintaining the battery temperature (electrolyte) at the end of discharge at 27 Deg.C +/- .6 Deg.C or by applying the following correction factor;

$$Mc = Mr \quad 1-0.018 \ (Tf-27 \text{ Deg.})$$

Where: Mc = Corrected minutes
Mr = Minutes run
Tf = Temperature at end of discharge in Deg.C
0.018 = Temperature correction factor

NOTE: Test is valid if electrolyte temperature at end of discharge is 21 Deg.C to 32 Deg.C.

3.3 Charge Acceptance

3.3.1 Charge Acceptance is defined as that current, in amperes, that a new and previously untested battery will accept in a half-charged condition at 0 Deg.C under a 14.4 volt charging potential.

3.3.2 Test Procedure

The new and previously untested battery shall be charged according to paragraph 2.2 and subsequently discharged at 0.1 times the ampere-hour capacity (0.06 times reserve capacity) in amperes for 5 hours.

Place the battery in a 0 Deg.C ambient until stabilized.

3.3.3 Acceptance Criteria shall be 0.1 times the ampere-hour capacity (0.06 times the reserve capacity) expressed as amperes.

3.4 Resistance to Overcharge

3.4.1 Following completion of capacity tests, clean, dry and weigh the fully charged battery to the nearest .02kg.

Charge at 14.40 +/- .05 volts at a temperature of 40 Deg.C +/- 0.6 Deg.C. After 21 days, remove from charge, clean, dry and reweigh the battery.

3.4.2 Acceptance criteria shall be a weight loss not to exceed 3 grams per ampere-hour of rated capacity.

4. CYCLE LIFE TEST FOR PHOTOVOLTAIC BATTERIES (DIN 72311)

4.1 Testing Procedure

4.1.1 The battery is tested in a water bath maintained at 50 Deg. +/- 2 Deg.C

4.1.2 The test cycle is performed as follows:

Charge:
(a) Voltage 14.8 +/- .05 volts

(b) Maximum allowable current rate:
-- 0,5 times ampere-hour rating
DR
-- 0,3 times reserve capacity
(c) Time: 150 minutes

Discharge:
(a) Rate: same as 2,b above
(b) Time: 30 minutes

4,1,3 Alternately charge and discharge the battery for a total of 24 discharges and 25 charge periods.

4,1,4 The battery shall be allowed to stand in the 50 Deg,C water bath for 67 hours.

4,1,5 The test is complete if 50% of the rated capacity to a discharge end voltage of 10V is no longer reached during the 30 minute discharge.

4,1,6 The minimum battery life shall be 6 weekly cycles.

4,2 Terminal Strength

4.2.1 Top Stud Type

The terminal is designed to be mated with a sealed connector and secured by a special stainless steel nut. When the sealed connector is mated with the terminal and the nut is torqued to 20 N,m (15 lb,-ft,), then disassembled and the assembly cross-sectioned through the terminal stud, there shall be no visual evidence of movement of the stud within the lead.

4,3 Tilt Angles and Vent System Capability

4.3.1 Single Vent (330mm models)

The venting system is designed to contain the electrolyte in the battery under the following static conditions:

a. With the battery tilted toward the external vent -- 0 to 75 Deg. tolerance on a continuous basis.

b. With the battery tilted opposite the external vent -- tolerate tilting angle of 0-35 Deg. for several hours; will tolerate 0-20 Deg. maximum of a continuous basis.

c. In the end-to-end direction, angles of 0-60 Deg. are acceptable on a continuous basis.

5. PERFORMANCE-SELF DISCHARGE CHARACTERISTICS

When stored at 25 Deg. +/- 2 Deg,C, the battery will retain a minimum of 50% of its rated capacity one year when tested as follows:

a. Condition to 100% state of charge per Section 2,2

SECTION II -- RECEIVING INSPECTION

1. GENERAL

This specification outlines procedures for use by Delco Remy original equipment customers in determining whetner incoming maintenance-free batteries are acceptable.

2. STATE OF CHARGE

State of charge is indicated by measuring open circuit voltage (terminal voltage under no load) with a digital voltmeter having 0.01 volt resolution and +/- 0.1% or better accuracy. On units as received, terminal voltage (measured between 15 Deg. and 40 Deg.C) should be 12.58 volts.

NOTE: Batteries subjected to exceptionally long shipment times (such as overseas shipments) may fall below these levels.

Batteries with lower voltage may require charging to adequately meet load demands encountered during assembly.

3. HANDLING AND STORAGE RECOMMENDATIONS

Even though maintenance-free batteries have superior storage life as compared to antimonial batteries, stock rotation and storage conditions are still important. Stock rotation and storage of inventory at as low a temperature as possible are essential to retain a high state of charge. Oldest inventory should be used first. Inventory storage between 1 Deg.C and room temperature is recommended. Storage at 30 Deg.C instead of 20 Deg.C will approximately halve the time before boosting will be necessary.

4. SHIPPING RECOMMENDATIONS

To minimize the open circuit voltage should be approximately 12.40 volts or greater, when shipped from the assembly plant.

To obtain valid measurements, the batteries should be allowed to rest for 24 hrs. without charge or discharge before reading open circuit voltage.

SECTION III -- APPLICATION GUIDELINES

1. MOUNTING BASE AND COVER

The tray should be fabricated from a material of sufficient strength to resist wear, flexing and cracking. The tray should be flat and provide firm support for the battery. There should be no protrusions or projections in the tray or mounting that would be damaging to the battery. Should a tilt angle be anticipated, please consult Delco Remy for approval. Adequate clearance should exist between battery terminals and mounting cover to avoid accidental grounding. Cantilevered mountings are not recommended.

2. HOLD-DOWN

A top hold-down should be spaced a minimum of 15 millimeters from terminal posts to avoid possible ground paths. If a top hold-down is used, a non-corrosive, non-conductive coating is desirable. Hold-downs should be designed so that the battery will remain tightly secured during service and not become loose.

3. LOCATION

The battery(s) should be located in a well ventilated area where batery electrolyte temperature will not exceed 52 Deg.C (infrequent temperatures up to 77 Deg.C can be tolerated).

The battery vent ports should be free of obstruction so that any gases escaping can be freely dissipated into the atmosphere.

4. TORQUE

For torque at cable connections, refer to battery outline drawing.

5. SIZE AND PERFORMANCE

The battery should adequately meet the demands made upon it by the electrical system. Two criteria should be satisfied in selecting the correct battery for th pplication:

7.1 The performance should be such that the system will receive adequate backup capicity with the battery at 50% state of charge.

7.2 Capacity should be such that starting problems are minimized under those conditions where the battery must provide energy to the loads. In determining this capacity requirement, the electrical loads, PV system output, no sun days, minimum 50% state of charge, and daily sun must be considered.

8. CABLE CONNECTIONS

8.1 Top Stud Type

The battery terminals are designed to be mated with sealed connectors and secured by 1892161 terminal nuts torqued to 13.6-20.3 N.m (10-15 lbs.-ft.). To achieve proper sealing,

b. Place on stand at 25 Deg.C for one (1) year

c. Discharge per Section 3,2

minimum electrical resistance and to avoid terminal damage, terminal face design should be per figure below or equivalent.

The attachments at the battery terminals should not cause undue strain at the connections. There should be no sharp bends in the cables adjacent to the connections. The use of flexible cable in conjunction with large wire sizes is encouraged to avoid unnecessary stress at the battery terminals. The cables should be color coded to identify polarity (red-positive, black-negative) and restrained as appropriate to avoid abrasion and terminal stress.